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UK CL (Edition L) A3V
INT CL[5] A41D 13/00 13/02 31/00 31/02

(54) Thermoinsulative protective clothing system

(57) The clothing system, Fig. 3, comprises an inner layer of thermal insulative material, such as neoprene, and an outer layer which may, inter alia, be waterproof and vapour permeable. The inner layer is provided with dome - shaped, vented air pockets and with an inner lining. When the system is applied to a protective suit, the outer layer provides protection, e.g. against rain, wind, fire, chemicals and radiation, whereas the inner layer functions to allow vapour transfer from the wearer, through the domes and into the air space between the two layers, wherefrom the vapour can then leave via the permeable outer layer. However, upon immersion in cold water, the water pressure closes the vents in the domes, Fig. 5, to maintain the thermal integrity of the insulation. Ideally, the suit will cover the whole body except the face. The domes need not be vented in some instances. The system provides some degree of buoyancy and can be used in jackets, trousers, gloves, shoes and balaclava.

FIG. 3

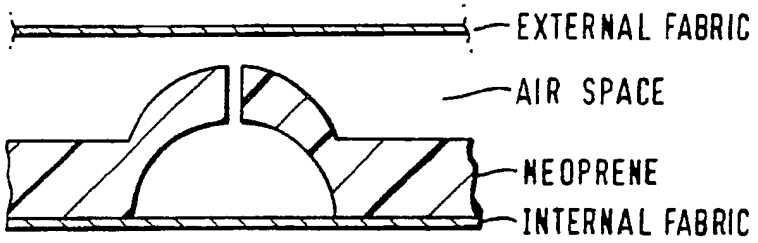

FIG. 5

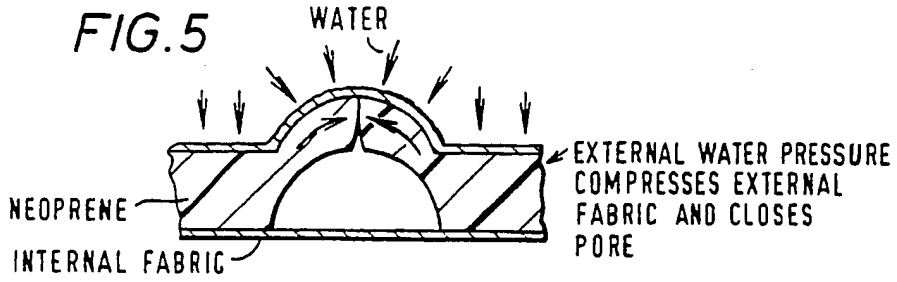

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FIG. 1

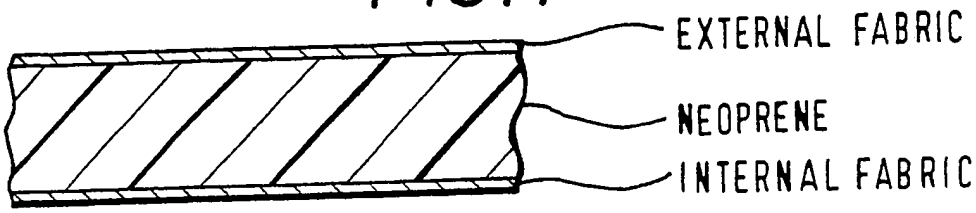
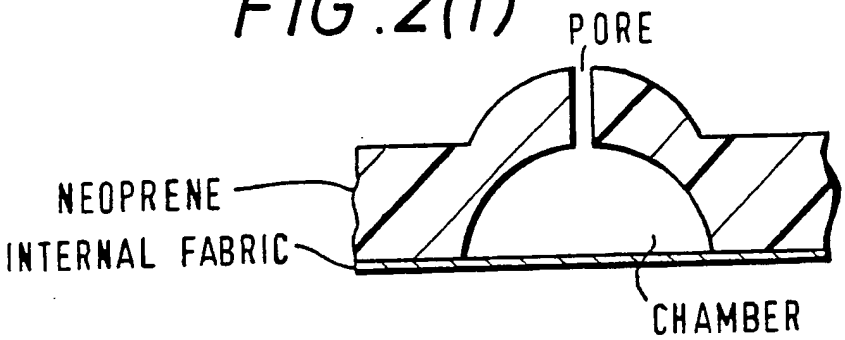


FIG. 2(i)



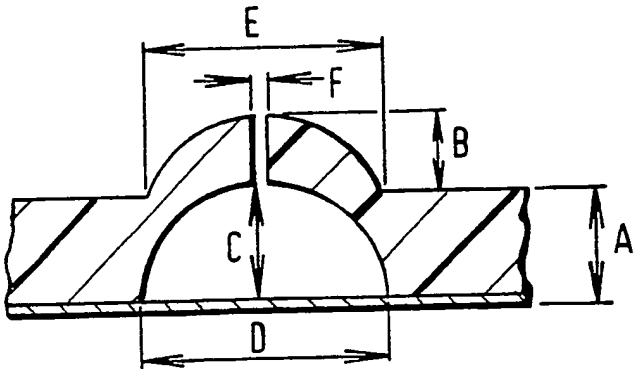


FIG. 2(ii)

FIG. 2(iii)

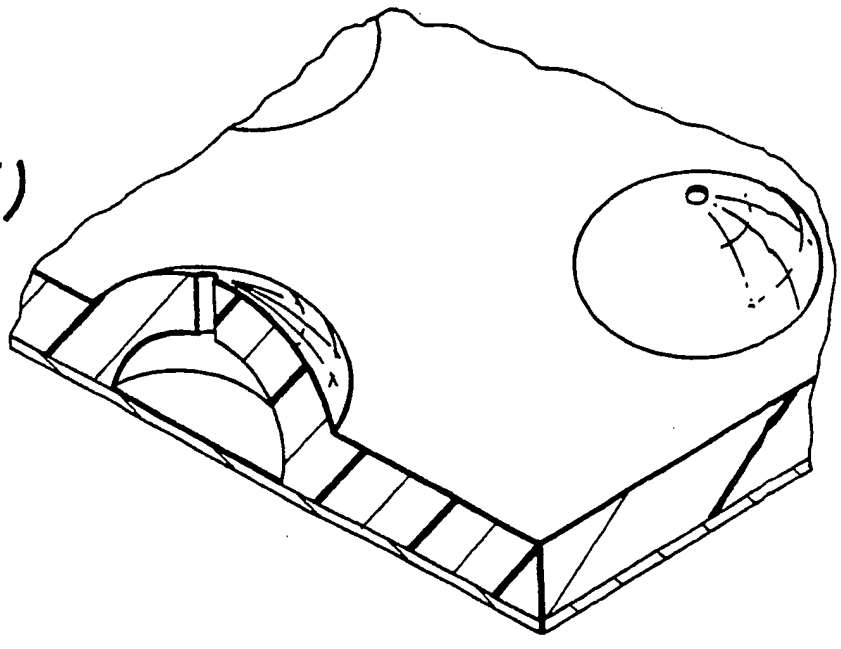


FIG. 3

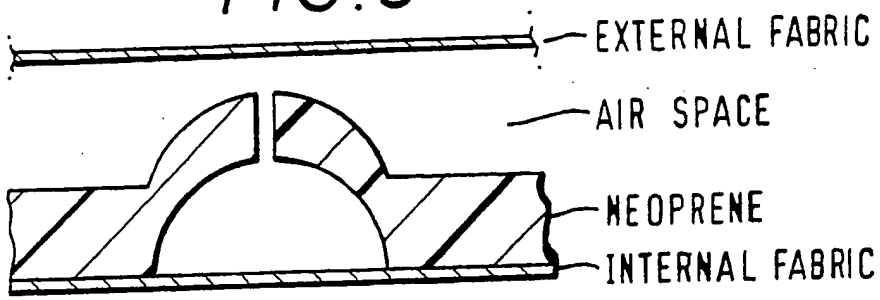


FIG. 4

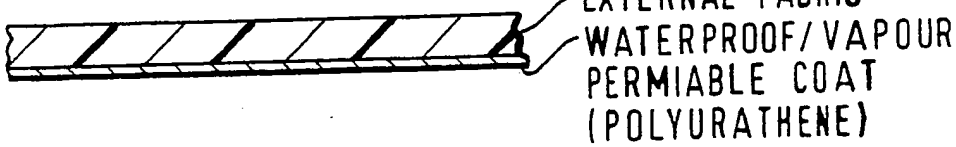
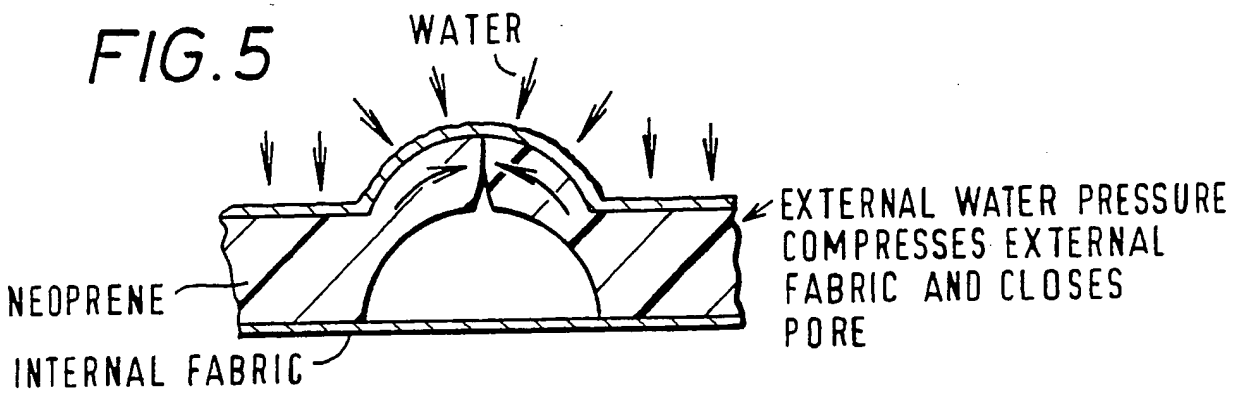


FIG. 5



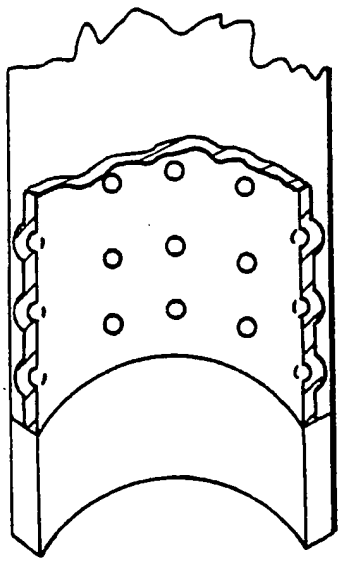


FIG. 6

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THIS INVENTION RELATES TO THERMOINULATIVE PROTECTIVE CLOTHING SYSTEM:

Thermoinsulative, protective clothing systems are well known and examples are wetsuits and survival suits, intended to protect the user from the detrimental effects of cold water immersion.

These systems are effective by providing a means of reducing the loss of body heat by conductive convection and radiation, through the insulative properties of materials of low thermal conductivity.

According to the present invention there is provided a thermally insulative fabric layer, applied directly to the skin surface, and intended to be close fitting.

The thermal insulator of this component layer is ideally closed cell neoprene but could be constructed from any suitable closed cell elastomeric foam.

The internal fabric lining can be constructed from any suitable cloth which provides comfort durability and stretch. This is permanently bonded to the neoprene component.

The external fabric component can be constructed from any suitable cloth which would provide the required properties of:- (i) durability, (ii) waterproof, (iii) fireproof, (iv) chemical proof, (v) vapour permiable (vi) Launderable, (vii) Machinability.

Vapour permability would ideally be provided by the use of a hydrophilic polymer coating such as polyurathane, (however any suitable waterproof/vapour permiable system may be employed).

The external fabric is not attached to the neoprene component and there is an air space between the two components under normal circumstances.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Fig 1: shows thermally efficient insulative fabric as utilised in the construction of conventional wet and dry suit systems.

Fig 2: shows details of a thermally efficient insulative fabric with active components of the invention which allows the fabric to 'breath' during dry conditions.

Fig 3: Shows the fabric/insulative component of the invention and its relationship with the external fabric component of the system which provides the outer garment.

Fig 4: show details of the external fabric component with its waterproof and vapour permiable coating.

Fig 5: shows cut away detail of the suit construction, indicating all the components and their relationship in the overal assembly.

Fig 6: shows details of cuff seals, and relationship of the two components of the clothing system.

Referring to the drawing Fig 2 this component comprises an internal fabric lining bonded to the thermal insulative elastomer by a suitable adhesive system.

Within the body of the elastomer has been formed the active component of the system, consisting of a chamber, a dome and a communicating pore.

The elastomeric sheet 'A' is of a thickness of 0.5mm to 10mm but ideally of 5.0mm.

The external height of the dome 'B' is between 0.5mm and 5mm ideally 2.5mm.

The external diameter of the dome 'E' is between 3.0mm and 20.0mm and ideally 15.0mm.

The internal diameter of the chamber 'D' is between 1.0mm and 18.0mm and ideally 12.0mm

The internal height of the chamber 'C' is between 1mm and 10.0mm and ideally 6.0mm

The diameter of the communicating pore is between 0.01mm and 5.0mm and ideally 1.00mm

The density of distribution of chambers/dome elements with a sheet of the composite laminate is between 500 per m^2 to 5,000 per m^2 and ideally 2,500 per m^2

The forming of the chamber/dome/pore component is carried out by the pressing of the closed cell elastomer at suitable temperature and pressure.

The pressure being between 50lb sq.inch. and 150lb sq.inch. and ideally 100lb sq.inch.

The temperature being between 100°C and 200°C and ideally at 150°C.

Referring to Fig 3: this shows the neoprene component previously described in Fig 2: and its relationship with the external fabric component.

There is also shown an air space between the two components and the only place where joining occurs is at the cuff seals at ankle, wrist and neck.

The external fabric component comprises the construction element of the outer suit.

It is constructed of any suitable fabric ideally with the following properties.

(i) durability
(ii) heatproof
(iii) fireproof
(iv) chemical proof, (biological, radiation)
(v) vapour permiable
(vi) laundrable
(vii) machineable
(viii) waterproof.

Referring to Fig 4: this shows the external fabric element and its hydrophilic polymer coating to provide waterproof/ vapour permiable properties. However, any such suitable system may be employed.

All other properties are achieved by appropriate treatments which are well documented.

Referring to Fig 5: this shows the closure of the communicating pores during immersion in water.

Referring to Fig 6: this shows a cut away domonstrating the relationship of the various components within the overal system at the point where internal and external components join at a cuff seal.

The construction of the suit involves the use of the fabric components previously described.

The suit is intended as whole body coverage and gloves, shoes, and balaclaver can be incorporated as required.

In the case of exclusion of gloves, shoes and balaclaver a rubber cuff seal is utilised at wrist, ankles and neck in a similar manner to that utilised in conventional dry suit system.

The suit is opened by suitably placed waterproof zip fastners. The internal (neoprene) suit is intended to be worn close to the body but allowance must be made for the use of undergarments.

The external suit (fabric) is intended to be loose fitting as in a coveral or boiler suit type garment. It can be designed to contain details which would benefit the user, i.e. pockets etc.....

The two components of the system are joined at the cuff seals, and at all other points there is free movement and an air space between the two layers.

All seams are constructed in a manner as to render them as impermiable to liquid water.

There now follows a description of the function of the system as a means of protection from unfavourable enviromental conditions.

The system is intended to provide user comfort and protection in a wide variation of enviromental conditions.

Under conditions of dry useage the neoprene provides protection from variance in enviromental temperature by virtue of its poor thermal conductivity.

At the same time the external fabric component provides durability and protection against rain, wind, fire, chemicals, radiation etc....

The chambers and pores of the neoprene provide a means of allowing vapour transfer from the user into the air space between the two components. This maintains a relaatively dry and comfortable enviroment at skin surface for the user.

The exhausted water vapour can then leave the system by passing through the vapour permeable coating of the external fabric.

During cold water immersion the pressure of the water compresses the domes and causes the closure of the communicating pores.

With the closure of the communicating pores, the thermal integrity of the insulative elastomeric foam component is reestablished.

The system is waterproof by virtue of the hydrophilic polymer coating and therefore no water can enter the space between the two components of the system. If accidental water entry occurs the neoprene will act as a semi dry suit and therefore its thermal efficiency will not be compromised.

The suit is intended for use in dry conditions for extended periods of time, having the ability to transform into a semi dry suit upon immersion in water.

Ideally this system is intended to cover the whole surface of the body except the face, with a single integral suit. However the system can be utilised in the construction of particular items of clothing, i.e. jacket, trousers, gloves, shoes, balaclava.

In some instances the chambers may be constructed without the communicating pores. This allows for an enclosed cell of warm air to accumulate, thus increasing the thermal insulative properties of the fabric.

CLAIMS:

(1) A thermal insulative fabric system, principarly comprising of two component parts.

Part 1: A thermal insulative layer constructed from an efficient thermal insulator such as closed cell neoprene.

Part 2: An outer garment, constructed from suitable fabric as to confer suitable properties according to intended end use.

(2) The system is intended to allow the user to gain protection from hostile enviromental circumstances, in comfort, for extended periods of time.

(3) The system has the unique ability to transform its structure and hence alter its inherant properties with changes in enviromental conditions.

(4) The system has inherant buoyancy characteristics.

(5) The system does not rely upon the total exclusion of water to ensure its continued value as a thermally insulative clothing system.